ISSN 2278-3091
Volume 9, No.1.3, 2020
International Journal of Advanced Trends in Computer Science and Engineering
Available Online at http://www.warse.org/IJATCSE/static/pdf/file/ijatcse5291.32020.pdf
https://doi.org/10.30534/ijatcse/2020/5291.32020

A Comparative Analysis of Energy Efficient Mobile Offloading Mechanisms

[1]Anoop S, [2]Dr.J Amar Pratap Singh
[1] Research Scholar, Department of Computer Science and Engineering,Noorul Islam Centre for Higher Education, TN, India
[1]anoopsivasankar@gmail.com
[2] Professor, Department of Computer Science and Engineering, Noorul Islam Centre for Higher Education, TN, India

ABSTRACT

Mobile cloud computing is emerging approach in computer networks to increase the computation abilities of the mobile devices. Mobile Cloud Computing has proved its advantages in technical as well as in communication market. An intensive radical advantage of Mobile Cloud Computing (MCC) is computation offloading which enhances utilizing the computational power of cloud and enabling the mobile phone (MP) to execute resource and computation intensive applications. Mobile cloud computing through offloading saves processing energy and improves battery life, which is one of the most significant ways to minimize power consumption. In this paper, the objective is to give an analysis and extensive discussion of energy efficient mobile cloud computing offloading techniques in existence. In addition to that it aims to focus significant technology progress and challenges in this area for researchers to do further research.

Key words: Mobile cloud computing, Energy efficiency offloading, challenges

1.INTRODUCTION

Mobile Cloud Computing [1 [5] is a new computing technique that has developed from a collaboration of mobile and Cloud computing. It's motto is to provide best services and enhanced user experience to those who are using mobile devices without exhausting [22] end resources. It is described as a base platform in which both storage and processing of tasks finds a location outside for intensive task processing. From the view point of a user, a cloud task is equal as a task which might be downloaded or brought from a repository in which the processing strength is managed with help of cloud. Today, portable devices like tablets and smart phones are updated into omnipotent terminals with reliable CPU, multiple sensors and extensive memory. Still the life period of the battery is seemed as a distress. The users generally require well organized mobile devices, that project on extended battery life and a very low processing time. The mobile cloud computing adopts large amount of resources to authorize the implementations based to improve mobile performance and conservation of the battery life. A main concern in a mobile application platform is to identify a decision to deploy several individual tasks.

Offloading is turned to be an efficient method for life time extension of devices by executing processes of applications remotely.

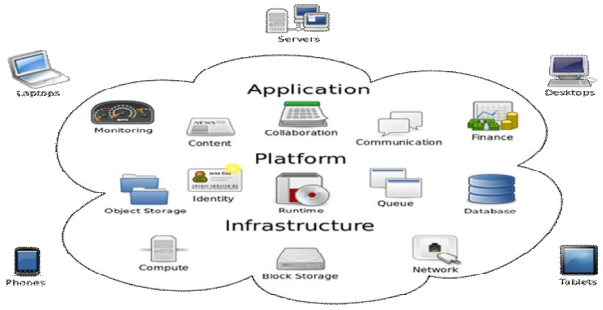

Figure 1: The cloud computing model.

The process of transferring the task that could able to run for assistance over the cloud resources has been regarded as the computation task offloading [2]. Thus the tasks which has to be offloaded from smartphone to a cloud server has to be decided based on some of the major factors like, task execution time, memory usage, processor utilization, network bandwidths, task upload time, task result download time, task allocation time, virtual machine scheduling time, local execution parameters, energy consumption[3][4][16] to offload task.

Mobile Computational offloading is based on a series of steps that are considered based on proper plan and design in their architecture .An ultimate decision on offloading is created by analyzing the proper time to under various device parameters, such as bandwidth, data transfer unit, and energy constraints. The second step is to choose the essential component to offload by splitting a specific application into local and remote parts .Third step is to find the correct place in which to be offloaded under various cloud resource possibilities and to identify the right path to offload by load balancing approaches.

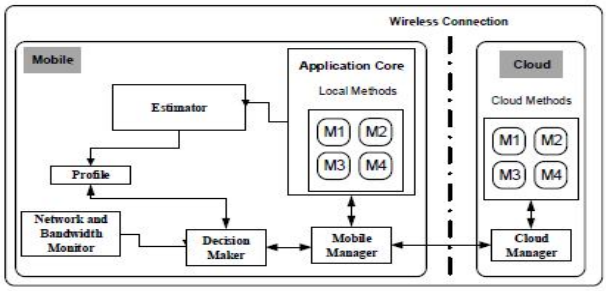

Figure 2: Offloading Service Architecture[6]

Figure 2 depicts the system architecture of offloading [6] consists of a profiler which take consideration of the deadline constraints and evaluate the metrics for deciding whether to offload or execute local. If offloading is necessary, then it transfers the partitioned data to remote cloud server for execution through wireless connection. Else it performs local computation if the constraints are below a threshold value evaluated by the estimator and there by improves overall efficiency of the system

To start computational offloading gathering of vital data constraints about available components are needed to make a decision. Then data partitioning [21] of available task into subtasks in order to analyze parts to be send to remote servers and make a clear distinction of non offloadable tasks to improve the offloading efficiency. A proper scheduling is required to place offloaded subtask to appropriate places in cloud servers and must establish and manage a connection with the remote server. A user is required to have a computer server, storage and mobile device which fulfills the requirement of energy efficiency by identifying a proper design A proper architecture and algorithms based on multiple perspectives must be created effectively and intellectually manage offloading.

2. LITERATURE SURVEY

In [7], Feng et al. developed an Opportunistic Mobile Network model based data offloading scenario which improves capacity of network together with an increase in efficiency in Heterogeneous Networks. In this paper, a Linear Programming methodology was used to resolve data offloading optimization problem and proved be NP-hard. To solve this, they created an algorithm for optimization with the help of dynamic programming, which reduces complexity of computation. Based on result, it is proved that the proposed system improve efficiency of data offloading together with enhancing capacity of Networks.

In [8], Liu et al. proposed a data offloading model to create architecture for mobile cloud computing by which data is send to other Mobile Networks. To minimize the cost, they formulated a model to offload a part of data to other nearby mobile networks. A finite horizon Markov Decision Process, and proposed hybrid algorithm to solve problem. Results proved that their proposed scheme performed much efficient than related offloading scenarios.

In [9] [10], Li et al. proposed the opportunistic mobile network based mobile data offloading problem by considering assumptions like size, lifetime, subscribing interests and buffer value of nodes. They formulate the optimization problem as a sub modular function maximization problem with multiple linear constraints assuming all nodes are collaborated with each other. To solve this problem, they designed a collaboration of Greedy Algorithm, Approximation Algorithm and Homogeneous Algorithm which will help in different data offloading scenarios. Based on extensive simulations, the proposed algorithms can effectively offload data to other Mobile Networks.

Buyya et al.[11] developed a model for offloading system considering a numerous cloud resources. For attaining the adaptive computing services, public clouds and mobile ad hoc network was used in providing the run time code offloading decisions in order to pick wireless medium was by context aware offloading decision algorithm. Based on the device, context potential cloud parameters act as the location for placing data. Evaluating the performance the real investigate was shown over the realized system. Cloud and wireless were related to mobile devices with different environment was designated utilizing embedded decision algorithm and it achieved better performance.

Cho et al. [12] introduced a new model that enables energy aware offloading. Instead of offloading all codes to cloud, MAUI will partition the application during runtime depending on cost parameters to increases energy savings. The results prove that this mechanism helps energy reduction together improves the performance of mobile applications.

Li et al.[13] explored total reduction of energy utilization together considering the reliability and time constraints. The study proposed a new energy-aware dynamic task schedule algorithm they facilitate directed acyclic graph and path assignment mechanism to get optimal order of execution for every task which minimized energy consumption.

S. Deng et al [14] suggested a novel offloading scheme for making decision to improve offloading of mobile applications which was influenced due to unstable mobile connection and relocation of devices. The dependency between relations was used for component services. This work scenario was used to optimize execution delay and energy analysis. A generic algorithm (GA) based method was implemented for offloading and introduced to meet the requirements of the problem. An effective solution was manipulated for overall cases studied around difficulty of linear algorithmic concerning size of problem and the encouraging experimental results were also attained.

K. Huang et al[15] proposed an energy efficient framework comprising a policies to control central processing unit cycles as method of computation to be performed locally together with mode selection and time division. Simulation work of proposed scheme out performed better in terms of feasibility and the gain optimal control.

S Josilo et al[16] presented a novel scheme to calculate the stable wireless and cloud resource allocations with the use of polynomial complexity algorithm and guaranteed price, that supports as an approximate ratio that was certain for solving problem of optimization. Thus an efficient system performance was achieved by means of the suggested algorithms and from the attained equilibrium without considering the access points and mobile user's counts, for several distributions of the task intricacy and size of data , and the low intricacy of this algorithms was established as well.

Zhuo et al. [17] on his paper introduced a framework to give a motivation to users to analysis their delay by the method of traffic offloading in cellular systems and found a comparative analysis based on the cost of the traffic offloaded and satisfaction of people .Gao et al. [18] analyzed the extend of offloading data and its compensations between cellular operators and Access point owners with the help of bargaining theory developed by Nash.

Yel et al[19] considers energy tradeoffs of multicore based offloading together with performance improvement. They created a multicore based computation problem into a mixed integer nonlinear programming problem. A novel algorithm minimizes the energy consumption together with helps to satisfy time constraints of mobile applications. Based on extensive simulations and real time experiments, algorithm dramatically reduces energy consumption compared to other approaches.
Ke Zhang et.al.[20] presents a multi device computation framework for mobile edge cloud computing for heterogeneous networks. To understand with the different access characteristics of heterogeneous networks, energy efficient optimization problem was formulated that drops energy consumption while reducing the latency. In order to cope up with complexity to solve the optimization problem, a hierarchical energy efficient computation offloading scheme was created through classification and assignment of task based on priority.

3. **CHALLENGE AND DISCUSSIONS**

The main focus of mobile cloud computing is to provide a proper and appropriate method for users to access and retrieve data from servers. These novel methods must be used to access cloud computing resources effectively by with the help of mobile. Mobile devices in cloud are subjected to resource-constrain. Due to limited resources issue constraints, computational and data intensive methods when deployed in mobile devices may consumes a large energy drain. So energy efficient mechanisms become a key research challenge. Offloaded data is subjected to security risk either from source and destination or communication channels. A security model is required to resolve this issue. Another challenge is placement of components and offloading decision making. Machine learning and Deep learning strategies plays a role in overcoming this issue. Another challenge with mobile data offloading is the absence in identification of global network information. Consistent and appropriate techniques of application data migration between servers is becoming a requirement challenge (table 1).

Table 1: Comparison table for Energy Efficient Offloading Models

Offloading model	Granularity	Energy Efficiency	Security	Performance improvement
Opportunistic Mobile Network model[7]	Yes	Yes	No	Yes
MDP approach cloud offloading[8]	-	Yes	No	Yes
A Context Sensitive offloading scheme[11]	Yes	Yes	-	Yes
Incentive Framework For Cellular Traffic Offloading[17]		Yes	No	Yes
Energy-efficient Offloading for MobileEdge Computing Networks[20]	Yes	Yes	No	Yes
Energy-efficient Multicore-Based Mobile Devices[19]	-	Yes	-	Yes
Selfish decentralized computation offloading[16]	-	Yes	No	Yes
Energy optimization with dynamic task scheduling[13]	-	Yes	-	Yes

4. **CONCLUSION**

Executing different high processing applications on mobile devices is a challenge since mobiles are equipped with limited resources. Mobile Cloud Computing being a combination of cloud computing and mobile devices alleviates these resource limitations. How to offload computation intensive parts effectively from mobile devices to different cloud servers is one of the key design issues. Security of the data which is offloaded to cloud and offloading decision making open research challenges in data offloading technology. This paper describes about the aspects and importance of energy efficient computational offloading approaches in constrained devices for the future generation. More precisely, the paper compares current frameworks for computation offloading together with techniques used to improve smartphone capabilities.

REFERENCES

1. Y. Wang, Q. Xie, X. Lin, and M. Pedram, "Energy and performance-aware task scheduling in a mobile cloud computing environment," in 2014 IEEE 7th international conference on cloud computing, 2014, pp. 192-199.
2. M. R. Rahimi, J. Ren, C. H. Liu, A. V. Vasilakos, and N. Venkatasubramanian, "Mobile cloud computing: A survey, state of art and future directions," Mobile Networks and Applications, vol. 19, pp. 133-143, 2014.
3. S. Sivakumar and A. Al-Anbuky, "Dense clustered multichannel wireless sensor cloud," Journal of Sensor and Actuator Networks, vol. 4, no. 3, pp. 208–225, 2015.
4. K. Gai, M. Qiu, H. Zhao, L. Tao, and Z. Zong, "Dynamic energy-aware cloudlet-based mobile cloud computing model for green computing," Journal of Network and Computer Applications, vol. 59, pp. 46-54, 2016.

5. K. Akherfi, M. Gerndt, and H. Harroud, "Mobile cloud computing for computation offloading: Issues and challenges," Applied computing and informatics, vol. 14, pp. 1-16, 2018.
6. I. Elgendy, W. Zhang, C. Liu and C. Hsu, "An Efficient and Secured Framework for Mobile Cloud Computing," in IEEE Transactions on Cloud Computing,June 2018
7. W. Cao, G. Feng, S. Qin, and M. Yan, "Cellular Offloading in Heterogeneous Mobile Networks with D2D communication Assistance," IEEE Transactions on Vehicular Technology, vol. 66, no. 5, pp. 4245-4255, May 2017
8. D. Liu, L. Khoukhi, and A. Hafid, "Data Offloading in Mobile Cloud Computing: A Markov Decision Process Approach," in Proc. IEEE ICC, May 2017, pp. 1-6.
9. Y. Li, G. Su, P. Hui, D. Jin, L. Su, and L. Zeng, "Multiple Mobile Data Offloading through Delay Tolerant Networks," in Proc. ACM CHANTs, Sept. 2011, pp. 43-48.
10. Y. Li, M. Qian, D. Jin, P. Hui, Z. Wang, and S. Chen, Multiple Mobile Data Offloading through Disruption Tolerant Networks," IEEE Trans. on Mobile Computing, vol. 13, no. 7, pp. 1579-1596, July 2014.
11. B. Zhou, A. V. Dastjerdi, R. N. Calheiros, S. N. Srirama, and R. Buyya, "A context sensitive offloading scheme for mobile cloud computing service," in 2015 IEEE 8th International Conference on Cloud Computing, 2015, pp. 869-876.
12. Cuervo, E., Balasubramanian, A., Cho, D. K., Wolman, A Saroiu, S., Chandra, R., & Bahl, P. (2010, June). MAUI: making smartphones last longer with code offload. In Proceedings of the 8th international conference on Mobile systems, applications, and services (pp. 49-62). ACM.
13. Y. Li, M. Chen, W. Dai, and M. Qiu , "Energy optimization with dynamic task scheduling mobile cloud computing," IEEE Systems Journal Journal, vol. PP, no. 99, pp. 1 1–10, 2017.
14. S. Deng, L. Huang, J. Taheri, and A. Y. Zomaya, "Computation offloading for service workflow in mobile cloud computing," IEEE transactions on parallel and distributed systems, vol. 26, pp. 3317-3329, 2014
15. C. You, K. Huang, and H. Chae, "Energy efficient mobile cloud computing powered by wireless energy transfer,"IEEE Journal on Selected Areas in Communications, vol. 34, pp. 1757-1771, 2016
16. S. Jošilo and G. Dán, "Selfish decentralized computation offloading for mobile cloud computing in dense wireless networks," IEEE Transactions on Mobile Computing, vol. 18, pp. 207-220, 2019.
17. X. Zhuo, W. Gao, G. Cao, and S. Hua, "An Incentive Framework For Cellular Traffic Offloading," IEEE Transactions on Mobile Computing, vol. 13, no. 3, pp. 541-555, March 2014.
18. L. Gao, G. Iosifidis, J. Huang, L. Tassiulas, and D. Li,"Bargaining- Based Mobile Data Offloading," IEEE Journal on Selected Areas in Communications, vol. 32, no. 6, pp. 1114-1125, June 2014.
19. Yeli Geng, Yi Yang, Guohong Cao,"Energy-Efficient Computation Offloading for Multicore-Based Mobile Devices" IEEE INFOCOM 2018 - IEEE Conference on Computer Communications
20. Ke Zhang, Yuming Mao, Supeng Leng, Quanxin Zhao, Longjiang Li, Xin Peng, Li Pan, Sabita Maharjan, Yan "Energy-efficient Offloading for Mobile Edge Computing in 5G Heterogeneous Networks" IEEE Access2016
21.F. Gu, J. Niu, Z. Qi, and M. Atiquzzaman, "Partitioning and offloading in smart mobile devices for mobile cloud computing: State of the art and future directions," Journalof Network and Computer Applications, 2018.
22.Vinodh P Vijayan, Biju Paul " Traffic scheduling for Green city through energy efficient Wireless sensor Networks "International Journal of Advanced Trends in Computer Science and Engineering, Volume 8, No.4, July – August 2019,ISSN2278-3091,
https://doi.org/10.30534/ijatcse/2019/81842019